

Quantum Numbers – Worksheet 2

1. For each value of l , identify the orbital name (s, p, d, f , etc), the shape, and the possible values of m_l .

	Orbital Name	Shape	Possible values of m_l
$l = 0$	s	Sphere	0
$l = 1$	p	Dumbbell	-1, 0, 1
$l = 2$	d	Four-leaf clover	-2, -1, 0, 1, 2
$l = 3$	f	Complex	-3, -2, -1, 0, 1, 2, 3

2. Provide the all the possible values for the other three quantum numbers for electrons in:

a. $n = 2$

	Possible Values	
l	0	1
m_l	0	-1, 0, 1
m_s	+1/2, -1/2	+1/2, -1/2

b. $n = 3$

	Possible Values		
l	0	1	2
m_l	0	-1, 0, 1	-2, -1, 0, 1, 2
m_s	+1/2 -1/2	+1/2 -1/2	+1/2 -1/2

3. Which of the following represents a permissible set of quantum numbers? (answer “yes” if permissible and “no” if not permissible)

	n	l	m_l	m_s	Permissible? (If not, why?)
a.	2	2	1	-1/2	Not permissible: l cannot be 2, it can only be 0 or 1.
b.	5	1	0	+1/2	Permissible
c.	6	3	-2	+1/2	Permissible
d.	7	0	0	-1/2	Permissible
e.	4	1	3	+1/2	Not permissible (The possible m_l values here are -1, 0, 1)
f.	1	1	0	+1/2	Not permissible (l values are from 0 to $(n-1)$, so $l = 0$ here.
g.	2	3	-2	-1/2	Not permissible, since values of l range from 0 to 1.

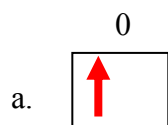
4. How many electrons in an atom can have the quantum numbers starting with:

a. $n = 4, l = 3$ (Since $l = 3$, we are talking about d orbitals. Since there are 5 d orbitals, there can be up to $5 \times 2 = 10$ electrons).

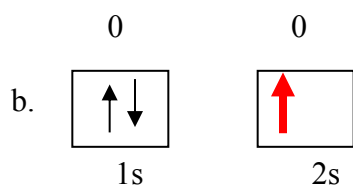
b. $n = 2, l = 1, m_l = -1$. (There are 2 electrons maximum in every orbital).

- d. $n = 3, l = 2$ (There are 5 d orbitals, therefore $2 \times 5 = 10$ electrons)
 e. $n = 3$ There can be up to $2 \times (3)^2 = 18$ electrons (note that at level n there can be up to $2n^2$ possible electrons)

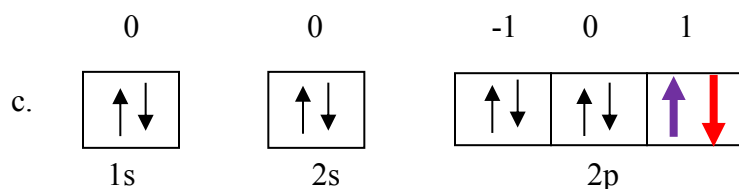
5. Write the values for the quantum numbers for the **bold** electron(s) in the following orbital diagrams (note that the orbital name and the possible m_l values are provided).



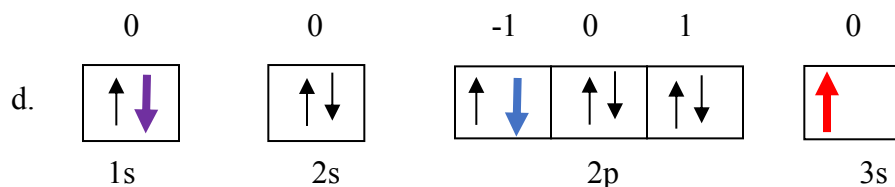
1s
 $n = 1, l = 0, m_l = 0, m_s = +1/2$.



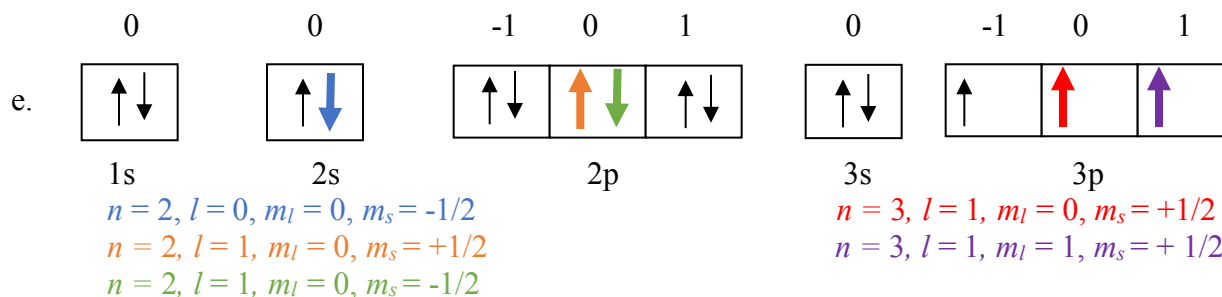
$n = 2, l = 0, m_l = 0, m_s = +1/2$.



$n = 2, l = 1, m_l = 1, m_s = +1/2$.
 $n = 2, l = 1, m_l = 1, m_s = -1/2$



$n = 1, l = 0, m_l = 0, m_s = -1/2$
 $n = 2, l = 1, m_l = -1, m_s = -1/2$
 $n = 3, l = 0, m_l = 0, m_s = +1/2$



$n = 2, l = 0, m_l = 0, m_s = -1/2$
 $n = 2, l = 1, m_l = 0, m_s = +1/2$
 $n = 2, l = 1, m_l = 0, m_s = -1/2$
 $n = 3, l = 1, m_l = 0, m_s = +1/2$
 $n = 3, l = 1, m_l = 1, m_s = +1/2$